PITFALLS AND OPPORTUNITIES IN THE USE OF MARKET-BASED INCENTIVES FOR BIODIVERSITY CONSERVATION

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Market arrangements fail to capture the range of benefits provided by conservation because of their public goods nature. In consequence, biodiversity is routinely undervalued and overexploited. A variety of instruments and payment schemes have been developed to help finance conservation by capturing these non-marketed benefits. This paper reviews market-based approaches identifying the salient features which determine their potential for improving conservation finance.

Key words: Market-based Instrument, Payment for Ecosystem Services, biodiversity conservation, environmental decision making

INTRODUCTION

Market-based mechanisms have taken a respected position among the tools for achieving both conservation and broader environmental objectives. The title of the reports, "Harnessing Market Forces to Protect the Environment," (Project 88 Conference 1989) and "Harnessing Markets for Biodiversity" (OECD 2001) are suggestive of the expectations placed on the power of market forces to achieve environmental goals. Other titles on the subject, such as "Silver Bullet or Fool's Gold," (Landell-Mills and Porras 2002) suggest that more circumspection is necessary before wholesale acceptance of market-based mechanisms as tools of biodiversity conservation. Market-based mechanisms are based on the market forces of supply, demand and trade. They rely upon price-type signals and trading among agents responding to economic opportunities, such as increased incomes or lower costs. Instruments considered to be "market-based" include:

1. Price-based instruments, such as taxes for undesirable behaviours, such as habitat degradation, pollution or species takes, fees, and penalties;
2. Price-based instruments, such as subsidies, to reward desirable behaviours, such as maintenance of land under forest cover, debt-for-nature swaps and conservation easements;
3. Price-based liability approaches such as deposit-refunds and performance bonds;
4. Quantity-based instruments involving market creation and trading of responsibilities, such as wetland mitigation banks, carbon credits, fishing permits and land development rights;
5. Demand enhancements and information disclosure, such as eco-labelling, and certification.

The first and perhaps most important surrounding the use of market-based incentives is that, from an economic perspective, environmental problems have traditionally been explained as results of market failure or the absence of markets. The market failure perspective poses several questions that are not answered satisfactorily by the conventional economic approach to environmental problems.

- First, when and how is it possible to transform the problem setting under interest so that quasi or real markets can be created where none existed before?
- Second, what economic, distributive and governance advantages or disadvantages do market-based instruments offer in comparison to government-centered regulatory solutions or public supply?
- Thirdly, what is the full range of market-based solutions that are applicable for conservation?
- Fourthly, what are the key issues that determine which market-based solutions can be expected to support conservation?

The purpose of this paper is to address these questions and consider the role that market-based instruments can play in achieving conservation objectives. While there certainly may be opportunities, there are also pitfalls that must be avoided in implementing these instruments for conservation.

1. Market failure versus ecosystem services as the basis of conservation transforming the problem setting

Conventional welfare economics suggests that environmental problems are caused by the absence of markets or by market failures such as externalities, public goods, and

Paper read at the International Conference on 'Conserving Nature in a Globalizing India' at Bengaluru; February 17-19, 2009

imperfect information. This public goods element to environmental problems has suffered from consistency problems. Some scholars have defined public goods as goods that are provided publicly, others have underlined the difficulty of excluding unauthorized users as their hallmark, and still others have rightly associated public goods with non-rival or joint consumption. The lack of excludability and rivalry in consumption provides an incentive for consumers to free ride and disincentives to potential providers who are unable to exclude unauthorized users. From an efficiency point of view, this results in too high or low level of an environmental impact or service, and a corresponding suboptimal allocation of environmental resources. Conventional solutions have relied predominantly on command and control measures or the public provision of public goods.

In terms of externalities, conventional theory portrays environmental problems as unwanted side-effects of otherwise beneficial economic activities. It then suggests a narrow range of government-centered policy responses such as regulations, forgetting that government intervention is not always needed to resolve externality problems if agents can bargain with one another (Coase 1960; Cheung 1973). There is evidence that many jointly consumed or high exclusion cost goods have successfully been provided privately (Coase 1974) or communally (Ostrom 1990). Therefore, there may exist alternative working governance solutions which have been overlooked by the dominant policy paradigm.

An alternative framework for addressing environment/economic interactions stems from the view that biodiversity and ecosystem services play a fundamental role in sustaining all human activity, and that well-functioning ecosystems are germane to human welfare. The concept of ecosystem services has its roots in ecology, but many ecological economists have made it a starting point for their economic analysis. Ecosystem services can be defined as "the benefits humans receive, directly or indirectly, from ecosystems" (Costanza *et al.* 1997; Farber *et al.* 2006) or as "the end products of nature that yield human well-being" (Boyd and Banzhaf 2005). Ecosystem services are generated by ecosystem functions, such as regulation, habitat, production and information, which in turn are underpinned by ecosystem structures and processes (de Groot *et al.* 2002).

Ecosystem services are of unquestionable economic relevance. Costanza *et al.* (1997) have estimated that the value of the world's ecosystem services is at least $ 33 trillion annually. Balmford *et al.* (2002) have demonstrated that nature conservation often generates higher economic returns than intensive use of natural systems, which entails their conversion (Turner *et al.* 2003; Naidoo and Adamowicz 2005). A vast amount of more narrowly focused valuation research exists. However, natural systems should not be valued only in terms of the benefit streams they generate. Natural systems provide life support services and have "glue value", because they constitute the infrastructure without which the provision of ecosystem services would not be possible (Turner *et al.* 2003).

Ecosystem services' thinking has undoubtedly broadened possibilities for supporting biodiversity conservation. Ecosystem service approaches are steadily gaining currency in policy spheres with a number of recent governance reforms being either directly underpinned by such an approach or compatible with it. For example, the European Union's Habitats and Water Framework Directives create multi-level governance solutions with jurisdictions that respect spatial aspects of the pertinent resources. These governance solutions also recognise a range of user groups and involve them in planning and decision-making processes. The support of environmental protection measures under the European Common Agricultural Policy (CAP) in turn commissions ecosystem services from private providers. These payments for the provision of ecosystem services are not subsidies: they are prices paid for the provision of services to private providers, who own and control environmental assets such as forests, pastures, or agricultural land.

In recent years, lack of information or information asymmetries between potential market participants has come to seen as a further reason for missing or inefficient markets. For markets to develop in conservation related services, one set of required information is understanding the functioning of ecosystems and ecosystem services, their dependence on land cover or use and metrics for measuring service delivery over baselines. Recognition, and identification, and better scientific understanding of ecosystem services have therefore led to more voluntary, Coasian type bargains, between private parties.

Nestlé, which owns the natural mineral water sources of Vittel in France, protected the spring catchment area, which had been intensively farmed (with resulting nutrient run-off and pesticide residues), by purchasing and reforesting the catchment. It further reduced non-point pollution by signing 18-to-30-year contracts with the local farmers to reduce nitrate pollution (The Economist 2005). In 1998, a hydroelectricity company signed a voluntary agreement to pay a local NGO, the Monteverde Conservation league for the water-based services provided by the forest they own (Reyes *et al.* 2002). In the Philippines, a hydroelectric company also provides incentives to local communities for reforestation of a water catchment (Mero 2002). Conservation easements and land trusts are also examples

of self-organized private deals between organizations and landowners whereby a conservation or protection arrangement is privately negotiated and purchased.

2. What economic, distributive, and governance advantages or disadvantages do market-based instruments offer in comparison to conventional government-centered solutions such as regulation and public supply?

The choice of governance and institutional arrangements in the management or delivery of services affirms or redefines entitlements to environmental resources, and has thus both efficiency and distributive consequences. Choices between different instruments for biodiversity conservation are primarily about the distribution of wealth and income, and about the realization of sought-after conservation outcomes.

Characterizations of environmental policy instruments commonly distinguish between "command and control" measures and "market-based" measures. Command and control measures include a wide range of environmental regulations, binding environmental plans, and procedural requirements.

The common feature of both categories of policy instrument is the creation of entitlements to ecosystems or ecosystem services. Environmental regulations are often viewed purely as constraints but they do create entitlements (albeit non-transferable ones). Regulations that prohibit the use of substances such as DDT, or the taking of an endangered species, create the entitlement to be free from the adverse consequences of these actions. Similarly, the conditions of pollution permits issued under the US's Clean Water Act, vest in the polluter conditioned entitlements to the capacity of water courses to assimilate wastes. Such entitlements are less explicit than in the sphere of market-based instruments where there has been a better understanding of how they create transferable entitlements, which facilitate their exchange.

Conventional wisdom has it that compared to command and control measures, market-based instruments are better at achieving environmental objectives at lower cost to both industry and society. This is due to the ability to transfer responsibilities across parties, as in the case of tradable permits, and the incentives created by some instruments for parties to reduce environmental management costs through introduction of better technologies and practices. Evidence from pollution control programs supports this view. The US Acid Rain program used a trading scheme to reduce emissions of sulphur dioxide. The resulting market was estimated to have resulted in cost savings of $1 billion annually compared to the expected costs under a command and control approach (Stavins 2001). Some have argued that command-and-control regulations are not necessarily worse in this respect and caution against a blanket prescription for market-based approaches (Porter and van Linde 1995). Some authors argue that such approaches are more suited for the institutional context of modern nations, rather than developing countries (Russell and Powell 1996).

The choice of instrument type is often a matter of distributive justice. For example, many agri-environmental schemes recognize transferable entitlements of farmers while industrial polluters are often regulated. The latter often have market power which enables them to share costs of improved environmental protection with their customers by raising prices. Farmers have a far weaker position to do so in the markets for agricultural produce, so are more cost-conscious. Distributive justice is an important issue for conservation of biodiversity in both the developing and developed world. If the costs and benefits conservation accrue unevenly to different groups, those left with the costs are hardly motivated to contribute to conservation.

A disadvantage of market-based instruments is that they are not good in guarding against irreversibilities or dangerous outcomes. It is noteworthy, however, that regulatory restrictions on activities and market-based instruments can be complementary. For example, restrictions can be used to prevent irreversible and dangerous outcomes, like safe-minimum standards, and market-based instruments can be used to induce effective outcomes that go beyond these limits.

3. The full range of market-based instruments applicable for conservation instruments

Table 1 provides a summary of policy instruments conventionally deemed to be market-based.

4. Price-based instruments, such as taxes, fees, and penalties, for undesirable behaviours

These incentives have in common the fact that there is some "price" placed on an undesirable or desirable behaviour. There may be legal distinctions between taxes and fees, fees interpreted as a price for services "received." How and where taxes or fees can be levied depends on statutory or judicial requirements. Penalties are a "price" placed on proscribed or prohibited behaviours, and are punishments for violating, for example, legal responsibilities.

4.1 Opportunities related to taxes, fees and penalties

These pricing instruments may be effective in circumstances where there is clearly something to place a price on and where payments are collectable. Thus, the most commonly used price-based conservation related instruments

Table 1: Summary of policy instruments conventionally deemed to be market-based

Type	Instrument	Definition
Price-based instruments for undesirable behaviours	Direct	a compulsory unrequited payment not proportional to the good or service received in return for that payment.
	Fees Penalties Input/ output taxes	Price paid in remuneration for specific services.
Price-based instruments to reward desirable behaviours	Subsidies	an unrequited current payment for provision of a good or service.
	Indirect fiscal	fiscal incentives such as tax exemptions, capital grants, price guarantees and the provision of cheap credit.
	Payment for ecosystem services	A voluntary transaction in which an environmental service is bought by a minimum of one service buyer who, in return, compensates a minimum of one service provider, if and only if the provider secures that service.
	Conservation easements	A legal agreement between a landowner and another entity, that permanently limits land uses of the property in order to protect conservation values.
	Auctions	Competitive tendering process.
Price-based liability approaches	Deposit refunds	Monetary deposits paid by consumers at the time of purchase and returnable when items are returned.
	Performance bonds	Deposits required from extractive industries refundable if the payer fulfils certain obligations.
Quantity-based instruments	Cap and Trade	Markets in which established rights or allowances can be exchanged.
	Biodiversity offsets	Conservation actions intended to compensate for the residual, unavoidable harm to biodiversity caused by development projects, so as to ensure 'no net loss' of biodiversity.
	Tradable development rights	Rights to develop in conservation areas that can be sold for development rights outside a restricted area.
	Individual Tradable Quotas	Output/production controls that assign exclusive individual rights to harvest specific portions of an overall natural resource quota.
Product-based instruments	Ecolabels	Information systems for consumer products confirming the product has been produced in accordance with certain environmental standards
	Certification	Process of certifying claims made in relation to environmental standards.

include hunting, logging and fishing licenses, timber harvest taxes, export and import fees for traded flora and fauna, and protected area user fees. Timber harvest taxes are used in some developing countries although experiences with them have not always been encouraging (Kim *et al.* 2006). Timber harvest taxes should be based upon the full costs of logging

activities, otherwise there will be too much timber harvested relative to other uses of resources. These costs include not only direct logging costs, but also the costs of opportunities foregone, which may include the ecosystem services lost with forest conversion (Yaron 2001). With forestry, taxes to reduce harvesting could result in a wide range of ecological benefits in addition to just limiting biomass removal. Setting such taxes in a non-arbitrary manner is the key to using taxes for conservation. Knowing the ecological impacts of timber harvests, and evaluating those impacts in economic terms will be an important element in implementing such a tax.

Taxes are useful in resource use cases, where the behaviour is observable, there is something to tax, there is an identifiable agent to tax and property rights can be clearly established. If observation is difficult, punitive penalties may be the only meaningful deterrent, where penalties are set so high that they are extremely onerous if one is caught. Higher penalties must offset the higher likelihood that one will not be caught. Of course, the functioning of taxes is predicated on state capacity to collect taxes and to keep corruption at bay.

Taxes have been used in several developed countries such as the Netherlands, Sweden, and the United States to control nitrogen discharges from agricultural non-point sources. The primary motivations were to protect water quality and human health by such taxes, and also enhance riparian environments. Generally, an instrument will be more efficient the closer it is applied to the environmental damage but input taxes can be attractive instruments for controlling discharges from numerous non-point sources, because they entail lower monitoring and enforcement costs than other instruments, such as technological requirements. In Sweden, a tax of 0.2 Euros or about $ 0.25 per kilogram of nitrogen has reduced nitrogen utilization in agriculture by about 10 per cent (OECD 2001). Similar taxes have been introduced for pesticides. Although not common in developing country contexts, input taxes may have potential because they are relatively easy to implement with limited informational and institutional demands.

It is conceivable that the external costs of loss of biodiversity, associated with clearing native vegetation could be subject to tax but to date, such taxation has not been directly associated with conservation.

The tax system can be used to notionally capture willingness to pay for conservation in addition to making polluters pay for damage. Belize charges a tourist tax of $3.75 for each passenger arriving in country by plane or cruise ship, with the proceeds going to a national conservation trust that supports protected areas and other conservation activities. Costa Rica and other countries impose a tourism tax on the price of hotel rooms, some of which is earmarked for conservation. Fees are one of the easiest and most common price-based instruments for capturing willingness to pay and may cover access to protected areas or associated activities related to conservation (photography permits). Evidence suggest that fees charged do not always fully cover the willingness to pay of tourists attracted by nature (Naidoo and Adamowicz 2005)

4.2 Pitfalls

4.2.1 *Failure to define and assign property rights*

A critical requirement for price-based instruments is that the property rights associated with the "good or service" being priced are well-established and enforced. For example, setting a price on the degradation of wetlands will have no meaning if there is confusion about who "owns" the wetlands. The good or service that is priced must be clear, its units well measurable, and the rights well-established. These instruments will not work well where the institutions or cultural conditions are not conducive to establishing and accepting the concept of property rights.

4.2.2 *Behaviour must be observable and enforceable*

One precondition for the success of price-based approaches is that the behaviour be observable and capable of being monitored. This is not always the case; for example, in the enforcement of conservation easements in remote areas, or penalties for prohibited species takes or harvesting behaviour. Enforcement may be formal, such as monitoring by a resource agency, or informal, such as watchful citizens. The inability to adequately observe behaviour can lead to self interested agents avoiding compliance with contractual obligations. It can also lead to perverse effects such as the incentive to destroy an endangered species or habitat on one's property before it is discovered (Polasky and Doremus 1998; Lueck and Michael 2003). Developing countries, in particular, may have difficulty in collecting taxes or fees, and enforcing compliance with a price-based conservation system.

4.2.3 *Price incentives are most effective the more directly related to the undesirable behaviour*

The success of these incentives also depends upon the extent to which the "price" is directly related to the undesirable behaviour. While it may be more administratively convenient to levy the price on one behaviour, if this is not highly correlated with the undesirable behaviour, incentives are reduced and the instrument less effective. For example, suppose the sole conservation objective is to protect an endangered species from capture by humans; then a penalty levied on harm or harassment of a species would be the most

direct instrument. But suppose it is difficult or impossible to measure species harm directly. A second-best instrument may be a penalty for degradation of habitat associated with that species. This may still allow an agent to take the species by hunting even when the associated habitat remains undisturbed.

4.2.4 *Price incentives must be set at the proper margins of behaviour*

Price incentives must also be on the proper margins of behaviour to compel agents to respond in a desirable manner. For example, setting land development fees at a fixed rate independent of the level of land conversion creates fewer conservation incentives compared to a fee based on the amount of conversion. This is the same issue faced in designing fees for water use; a fixed fee may not induce consumers and firms to cut back on water use. The downside to pricing on the proper margins of behaviour is that agents may attempt to avoid the levies through undesirable actions; e.g., illegal habitat conversion or water theft. So, enforcement of the levies may require observing both legal and illegal behaviours.

4.2.5 *Prices must be set at the correct levels*

Setting prices at the correct level is another precondition for success. In general, if we want to see behaviour at a certain level, such as a number of acres remaining undeveloped, we must know what the cost of that behaviour is for agents in terms of the benefits foregone from not pursing alternative options. Then the prices must be set at a level somewhat in excess of that cost. If the price is set too low, it is cheaper for the agent to pay the tax, fee, or penalty, than to engage in the behaviour we seek to achieve. For example, if a landowner can obtain an additional income of $100 from some activity we would like to discourage, a price of at least $100 must be levied to discourage that behaviour. Unfortunately, we cannot always know these costs to agents. The more uncertain we are about agent costs, the more likely it is that prices will have to be altered to achieve acceptable outcomes. This problem arises because of imperfect information about the opportunity costs agents face and compounded by the fact that agents, whose behaviour we seek to change, may face very different opportunity costs for undertaking the same actions. Auction mechanisms are one means of addressing this informational asymmetry. If there is considerable likelihood that some behaviour could be especially deleterious, it may be more useful to simply proscribe the behaviour rather than use the more subtle pricing instrument. An example would be if it is absolutely critical to maintain a given area of wetlands for a critical conservation goal. Directly proscribing or prohibiting wetlands degradation may be more effective than using pricing instruments to ensure behaviour commensurate with the required habitat extent.

If pricing is based upon the benefits lost from some undesirable behaviour, a measure of these benefits must be established. For example, we must know the marginal value of wetlands services before we can set a benefits-based price on behaviours that degrade those services. This may not be simple. It may be easier to establish the cost to an agent for not engaging in the undesirable behaviour, suggesting that a cost-based price would be administratively easier.

When enforcement is uncertain, it is reasonable to consider setting prices at higher levels to account for the uncertainty. For example, suppose we wanted agents to effectively incorporate a price of $100 into their decision calculus before deciding to engage in some undesirable behaviour, such as dumping wastes into streams. But suppose there is only a 10 per cent chance that such behaviour will be observed by the enforcers. Then setting a price of $1000 would result in an expected price of $100 (10% x $1000). This is one of the arguments to assigning punitive damages; that enforcement is uncertain and it signals to other agents that the price of their undesirable behaviour will be high if they are caught. In this example, actual damages would be only $100, but the punitive damages would be $900.

4.2.6 *Uncertainty about expected benefits*

Another basis of pricing of behaviours is the benefits we expect to obtain when that behaviour is avoided. Under this interpretation, if the benefit of avoiding dumping into streams is $100, then setting the price at $100 at least allows recouping of damages. But if we do not know these benefits or they cannot be evaluated in monetary units, which is often the case, then setting a price based on benefits received is problematic. In such cases, reverting to prescriptive or proscriptive rules, such as permits or mandated actions, may be prudent.

4.2.7 *Agents must be responsive to the pricing instrument*

Another precondition for using these pricing instruments is that agents are responsive to these prices. It may be that agents are not highly rational, or do not make decisions based upon the same costs and benefits units as the prices. While pricing is perfectly general, i.e., the price can be monetary, or time, or chickens, etc., the prices may be in units that do not stimulate behaviour. The prices must have meaning. Monetary prices in a culture that is not highly monetized, or market oriented, may not be very effective. Also, there may be social reluctance to accept prices for things that were traditionally free.

4.2.8 *Inadvertent distributional consequences*

Such price-based mechanisms conform with the polluter pays principle with the statutory incidence of the tax falling on the polluter. The economic incidence of the tax may not. Depending in part on the elasticity of demand for the goods or services incurring the tax, businesses can pass on the tax in the form of higher prices for buyers, lower wages to workers or lower returns to investors.

5. Payments and Subsidies

Subsidies or payments for ecosystem services are the opposite of taxes, fees and penalties, and place prices on desirable behaviours. There is an important distinction between the two instruments. A payment for a service sets a price on the service, and agents can decide whether they wish to "sell" that service. A subsidy represents compensation to an agent for engaging in a desirable activity; the compensation can be direct or indirect, as in the case of tax breaks. The "pay for service" may have a different image to the public than the "subsidy for an activity." While subsidies are sometimes the cause of conservation problems, such as subsidies to the fishing industry that result in over-fishing (Myers and Kent 2001; Fujita *et al.* 2004) or agricultural subsidies that result in overuse of land, they can also be used to achieve environmental objectives. Payments for ecosystem services, where "producers" of environmental services (e.g., landholders whose forested land filters water) are compensated by "consumers" (e.g., downstream water users), are one such rapidly emerging mechanism. Despite their increasing popularity, these instruments do have pitfalls that need careful consideration. Payment systems include both fixed prices as well as auction-based prices.

5.1 Opportunities related to subsidies and payments

Subsidies and payments may be more effective than taxes, fees, or penalties in certain instances. For example, if an agent has the right to an activity, such as the right to develop land, subsidies or payments may be the only price-based instrument available to deter that activity under the initial assignment of property rights. This may be necessary in the case of species protection, as the legal battles in the US over the Endangered Species Act suggest. Paying people to save species rather than penalizing them if they do not may be a useful, albeit expensive, solution (Jenkins *et al.* 2004). Also, compensating persons who have been harmed as a result of conservation programs, such as farmers whose crops are damaged by preserving elephant herds, would increase the likelihood of harmed parties agreeing to the programs. It may be less costly simply to pay agents to do something rather than face what may be protracted legal costs.

Subsidies and payments may also be the most useful instrument when equity issues dominate a conservation objective. In many instances, conservation requires a few to bear the costs that benefit many. If this circumstance is viewed as too unfair, giving a subsidy may be more acceptable than a tax, fee or penalty. This may be particularly important in agriculture, as farmers are often viewed as being marginal economic enterprises.

Subsidy programs may offset costs to agents of engaging in conservation activities. Subsidies may be in the form of tax deductions or coverage of costs. For example, a Brazilian program, ICMS Ecológico, awards a share of national sales tax collections to municipalities if they engage in programs to establish restricted areas (Grieg-Gran 2000). This is presumably to offset the costs in lost revenues to municipalities from restrictions on land use and development. Ontario, Canada, has a tax incentive program for land conservation, whereby landowners can receive 100% property tax relief for preserving land in acceptable condition. Eligible lands include provincially "significant" wetlands, habitats for endangered species, and lands of natural and scientific interest. (http://www.mnr.gov.on.ca/MNR/cltip/).

The Environmental Stewardship program in England is a good example of a payment scheme (http://www.defra.gov.uk/erdp/schemes/es/default.htm). Farmers receive payments per hectare in return for accepting a package of management measures. Each management option receives a number of points, and the farmer is then paid based on the number of accumulated points. Points can be awarded based upon national or local significance and priorities. Since the program began in 2006, over 3 million hectares have been enrolled with 23,000 agreements and over £105 million have been paid.

In developing nations with weak regulatory and taxation systems, paying for ecosystem conservation may be one of the most effective ways to achieve conservation goals. The best known ecosystem service payment system outside of high-income nations is the one established by Costa Rica in 1995. The scheme was designed to enhance and sustain forested ecosystem services, including carbon sequestration, biodiversity, watershed management, and landscape beauty. The program pays landowners US$202/ha for forest protection, US$314/ha for sustainable forest management, and US$516/ha for reforestation (Miranda *et al.* 2004) for a contracted five years of protection. The state's National Forestry Finance Fund (FONAFIFO) purchases these services, then sells them to interested buyers. For example, it may sell carbon sequestration credits to international buyers, watershed management credits to national hydroelectric utility companies. So it is a hybrid purchase and trading program,

where the state is the trading agent.

Literature on information economics has forced policy makers to reassess policy mechanisms employed for many policy problems and has led to increasing interest in auction based approaches for publicly funded biodiversity programs rather than fixed price approaches (Stoneham *et al.* 2003). In negotiating biodiversity contracts, the conservation agency and potential participant will have varying information regarding the ecological worth of landholdings and on the opportunity costs of conservation. Auctions can help address this information asymmetry and potentially achieve greater conservation outcomes at lower cost than fixed payment schemes. The Australian Catchment Care program is an example of such an auction-based scheme to achieve cost-effective natural resource management actions (http://www.napswq.gov.au/mbi/round1/project26.html). In this recently developed program, landholders bid for contracts to establish conservation activities. These activities are scored on the bases of environmental value and threats. The score is then related to the proposed landholder cost; and proposed contracts are ranked on a cost-effective basis. Contracts are established for the most cost-effective bids until funds are exhausted or a reservation cost-effective price is reached. A full trial of the scheme was run in a watershed, where 29 bids were submitted, and 17 were selected for funding.

Another example of an auction-based payment scheme is the Bush Tender program in Australia (http://www.ecosystemservicesproject.org/html/publications/docs/Intro_to_MBIs_2005.pdf). Farmers proposed bids for projects that were then ranked by their biodiversity benefits. Winning bids were then selected based on their cost-effectiveness. Analysis of the program concluded that the auction approach delivered 25% more native vegetation for the same cost as a grants scheme.

The auction-based payment schemes are useful as they utilize competitive forces to achieve the most cost-effective conservation goals. However, they are administratively complex and require measurements of conservation outcomes, a task that may not be simple, depending on the outcomes desired. Useful measures of outcomes require more than just measures of land area impacted.

Payment schemes are not limited to government sponsored programs. Private agents may have sufficient incentives to pay for services useful to them. As noted, the Perrier-Vittel company, which sells bottled water, has financed reforestation and is working with farmers to develop less polluting management practices (The Economist 2005). In South Africa, a private ecotourism company, Conscorp, pays landowners to restore farmlands and stock them with native wildlife (Heal 1998). These are good examples of Coase's argument that government intervention may not always be necessary to manage externalities.

Both public sponsored and self organized deals have also created markets based on the establishment of property rights and the environmental aspects of assets, such as non-developed state of land. Development rights and other rights can be distinguished from other property rights and traded separately by using, for example, conservation easements.

Land trusts and conservation easements are widely used in the United States and elsewhere to pursue conservation goals. Land trusts purchase land for conservation or buy development rights or conservation easements on land which remains in external ownership. In Indiana, Sycamore Land Trust has been one flexible tool for attaining local conservation goals without the involvement of the state (York *et al.* 2006) and land trusts have also been used in the Mountain West for landscape and open space preservation (Booth 2002). However, land trusts allocate the costs of conservation to the public, which means that availability of funds will curtail the volume of conservation. Enforcement of easements in the courts can also be costly and the continuity of land trust depends on private donations. There is also a possibility of conflict between local and wider conservation goals and priorities.

Tradable development rights may be useful to achieve land-based conservation objectives. The initial assignment of rights is critical to the acceptability of this instrument, as is the question of who can buy these rights. Trading rules must be well-defined and administered, as these rights may be economically meaningful and contentious assets. These rights may be either in the form of tradable rights to develop, or as development "reduction" credits. Conservation groups may be given the right to purchase. As in the case of all these market-based instruments, monitoring and enforcement are critical to success. Assuring that development does not occur where proscribed may not be easy. For example, Brazil is allowing such trading under its general rule that requires landowners in the Amazon forest to maintain half of their land in forest (Jenkins *et al.* 2004).

5.2 Pitfalls related to subsidies and payments

5.2.1 *Property rights must be well-defined*

Altering behaviour is costly and these costs are the same to society whether subsidies (payments) or taxes (fees and penalties) are used to alter behaviour. The type of price used, subsidy or tax, defines property rights in status quo and determines who bears the cost of that change. Taxes leave the cost to private agent while subsidies redistribute the cost in part or in whole to the public. The argument for just compensation in takings is also based on the fairness issue of

who should bear the cost of an action.

5.2.2 *Political difficulties*

Subsidies may face political difficulties, as they may be viewed as paying agents to do something they should already be doing according to local norms or customs. For example, paying someone to stop using land in a certain way may be seen as implicitly sanctioning a use that was formerly taboo. Payments for actions may be viewed as more acceptable; even the terms "subsidy" and "payment" have different connotations.

5.2.3 *Financial limitations*

Subsidies and payments require funds to finance or can result in the loss of government revenues in the case of tax breaks. Financial limitations may restrict the use of subsidies.

5.2.4 *Permanence of outcome*

Related to financial limitations is the issue of permanence, a factor which must be considered when assessing appropriate mechanisms for biodiversity or ecosystem services. Assume a farmer is paid, through auction or subsidy, to fence off a stretch of native vegetation. When payments cease, she allows her cattle to graze the area, so that most of the benefits of biodiversity conservation will be lost. With water quality, in contrast, the benefits from the service of water purification will have been enjoyed throughout the contract.

5.2.5 *Perverse incentives*

Subsidies and payments can create perverse incentives. A subsidy or payment to avoid an activity may induce agents to engage in more of that activity. For example, paying agents to cease polluting a stream may cause them to want to increase proposed discharges in order to obtain higher subsidy payments. Subsidies and payments may also encourage entry and delay exit from an industry, exacerbating the original conservation issue. This latter issue is most likely to be a problem when the most inefficient firms/farmers are also the most environmentally damaging.

5.2.5 *Equity considerations*

In the Costa Rican example above, it is only farmers with property rights to land who can be paid for conservation.

5.2.6 *Costs of monitoring and enforcement*

Payments and subsidies are paid for taking specific actions, such as adhering to a specific land management plan, building storage capacity for manure, or setting land aside from cultivation. Their effectiveness depends on the ability to monitor compliance with applicable conditions and on the enforcement of these conditions. In many cases monitoring of compliance and enforcement are costly, which means that implementation and outcomes can fall short of the goals.

6. Deposit refund instruments

Deposit-refund instruments are specialized types of pricing instruments. Typically, a deposit is paid up front for an item or action, and a refund is given upon completion of some desirable action, such as return of the item or meeting some action criterion. Performance bonds require an up-front liability and, if the terms of environmental management are satisfied, the liability disappears.

6.1 Opportunities related to deposit refund instruments

Deposit-refunds on hazardous materials, such as oil and batteries can be helpful in reducing disposal risks and can therefore have a minor role to play in enhancing conservation. Performance bonds can play a more important role in achieving conservation or remediation objectives. These bonds are used in the US to secure funds to meet surface mining reclamation requirements. The mining company Gold Field's 2003 Annual Report noting that in Ghana, it funds environmental rehabilitation costs by posting a US$3 million reclamation bond, while in Australia, it guarantees its environmental obligations by providing the western Australian government with unconditional bank-guaranteed performance bonds to the amount of AUS$12.3 million. Whether such bonds are large enough, or remediation objectives are actually met are serious questions for the use of these instruments. For example, the state of Pennsylvania has had mining reclamation bonds in place for a long time, but the costs of acid mine drainage remediation have dwarfed the bond fund, leaving the citizens of the state with major unfunded cleanup costs. Bonds could be used to assure proper timber practices, as a pre-condition for wetlands development or as a condition for receiving a fishing permit.

6.2 Pitfalls related to deposit refund instruments

6.2.1 *Certifiability*

Pre-conditions for success of this instrument include certifiability that a deposit was paid on the items or actions for which refunds are claimed, and that the items or actions are as claimed. This is a problem, for example, in the recycling of used oil; the returned oil can be contaminated or purchased where deposits were not required. It is a problem with performance requirements for ecosystem restoration; a long monitoring period may be necessary to assess whether performance criteria are met. Such a long time period may be financially or politically unacceptable.

7. Quantity-based instruments involving market creation and trading

Whereas price-based instruments, notably taxes, provide security regarding the cost of a policy objective, quantity based instruments provide more certainty as regards specific policy objectives. These instruments rely upon the incentives of agents to trade responsibilities amongst one another. The classic cases are tradable permits for pollutants, such as sulphur dioxide and carbon dioxide, and tradable fishing quotas. The trades may be based on allowances, such as permitted emissions or fish catch, or on reductions, such as emissions reduction credits or reductions in fishing effort. Typically, agents are assigned some initial responsibility, e.g., allowable emissions, or required reductions, and if some agents are more successful than others in meeting those responsibilities they can trade responsibilities. Although there have been some voluntary cap and trade schemes, most such schemes depend on well-defined, enforceable legal and regulatory frameworks

7.1 Opportunities related to Trading

Tradable fishing rights have been used by a number of developed countries to manage fish stocks. Although resource management underlies their introduction, regulating fishing contributes directly to the wider health of marine ecosystems (McIntyre *et al.* 2007). Setting the allowable catch and then dividing up the rights can be difficult, requiring scientific, economic, and community knowledge. Enforcement can also be a problem, but can range from formal to community actions. Using trading instruments for more complicated conservation objectives may be problematic. Biodiversity conservation is complicated by the fact that there is a multitude of species and interactions that must be preserved. Trading based upon species, per se, or even "bundles" of species would not be a very effective or practical means of protecting biodiversity. Rather, trading of habitats, perhaps weighted for species potential or richness, may be a more useful application of trading. Australia is proposing a program creating tradable rights for landowners who conserve biodiversity on their land; and developers must obtain such rights from a common pool in order to develop land (Jenkins *et al.* 2004). Perhaps the most developed program for biodiversity mitigation is the US wetland banking program introduced under the Clean Water Act of 1972, where wetlands qualities can be used as weights (e.g., Habitat Units) for measuring credits. Both schemes are based on the notion of 'no net loss' of biodiversity. Some researchers have proposed tradable invasive species permits to protect biodiversity (Horan and Lupi 2005).

Another useful example is the recently developed scheme for protecting marine resources in a heavily trawl-damaged area off the coast of California (New York Times 2006). In order to reduce trawl fishing, several non-profit environmental groups have begun purchasing fishing permits from fishermen along the central California coast. The purchases, at a cost of several hundred thousand each, include both the permits and the boats. The environmental organizations then own the boats and permits, and can lease these to fishermen with restrictions on fishing locations and techniques. This would not have been a useful tool if the fishermen would have changed their locations and techniques favourably without the buy-out; but this did not seem to be the case.

In response to regulatory requirements for compensatory mitigation, conservation banks have been established to generate credits for habitat restoration. Conservation banks have been established to mitigate damage to a wide variety of ecosystems, including short-grass prairie and old-growth pine forests in the United States. The most well-known example of conservation banking is the U.S. wetlands banking programs that allow agents to bank and buy wetlands restoration and development credits. There are over 500 wetland mitigation banks operating. When mitigation ratios are set above 1:1, there can presumably be a net gain in wetlands. However, the extent to which banked wetlands represent the same functionality as developed wetlands, and the extent to which the banked wetlands are successful over the long term, limit the possible net gains (Salzman and Ruhl 2001).

Australia has used a trade mechanism to achieve cost-effective salt load reductions in the Hunter River (http://www.ecosystemservicesproject.org/html/publications/docs/Intro_to_MBIs_2005.pdf). Individual polluters are given initial licenses to discharge a given quantity of salt into the river. Polluters can then trade amongst themselves.

7.2 Pitfalls related to Market Creation and Trading

7.2.1 *Assignment and rights, and equity implications*

There must always be an initial assignment of rights. These will often be politically contentious. "Grandfathering" and auctioning are two possible assignment procedures for cap and trade schemes, each with their economic and equity implications. When the value of the permits is high, the initial assignment has significant financial equity implications, and also affects the trading itself. An agent with an initially large assignment has a significant asset, and may use that asset in undesirable ways. For example, if a few agents receive a large number of land development rights, they may be able to control development to their advantage simply by the possession of these rights; they may use them to drive

competitors out of business. In the Netherlands, large companies buy up fishing quotas and lease them to small operators, who receive little profits from their catch (www.colby.edu/personal/t/thtieten/fish-nz.html).

7.2.2 *Measurability and verifiability*

Pre-conditions for successful trading schemes include measurability and verifiability of trades. Tradable permits for pollutants meet these requirements, particularly in those countries that have well-developed permitting and measurement systems. But it is always possible for an agent to cheat by claiming fewer pollutants or greater reductions than is the case; or falsely claiming to have purchased more allowances or reduction credits than is the case. It is not inexpensive to measure and monitor trading schemes.

7.2.3 *Well-functioning trading market*

Another pre-condition for a successful trading scheme is that the trading market be well-functioning, meaning that trades are made when there are mutually beneficial circumstances for the traders. Small trading markets can be monopolized, defeating the presumed benefits of trading. Also, information must be available on what is for sale and who wants to buy. If there are willing buyers and sellers but they cannot find one another easily, the market will function at less than its potential.

7.2.4 *High transaction costs*

Trading involves transactions costs, such as finding sellers and buyers, and establishing the terms of trade. This may be a problem in the case of the CDM of the Kyoto Protocol where potential reforestation and afforestation projects involve many small landholders. Transaction costs can be so high as to prevent the project from going ahead, creating a barrier to small-holders entering the market and trading their carbon credits.

7.2.5 *Cultural pitfalls and strategic bargaining*

Trading schemes may not work in cultures that cannot understand the concepts of trading in such unfamiliar items as rights and actions. And they may not be successful in circumstance where agents are reluctant to give up presumed rights. This has been a problem in establishing water use rights trading in the Western US. While there is a huge difference between the low economic value of water use in agriculture and the high value of water in urban areas, farmers have been reluctant to give up water rights as that may forever alter their ability to farm. While there may be a high enough price at which a farmer will sell, this high price may foreclose any trades of water from low to high value uses. Strategic bargaining between trading parties may lengthen the trading process and even result in the foreclosure of what otherwise could have been mutually advantageous trades. A farmer may begin the bargaining by stating such a high price that buyers presume no reasonable deal can be made, or buyers set initially low prices that sellers walk away; this is a noted issue in residential house sales. The attempts to institute tradable quotas in New Zealand fisheries in the early 1980s were not accepted by the Maori people since it did not coincide with their view of common property resources.

7.2.6 *"Hot spot" problem*

Trading schemes must be set up to avoid adverse environmental consequences. Typically, trading results in shifting activities spatially. There are problems with trading schemes that result in too much of an adverse activity or too little of an activity in one location. An example of this problem can be found in the context of wetland mitigation banking (Salzman and Ruhl 2006). Although there may be no net loss in wetland area, wetlands near urban areas, where the hydrological services are most valuable, are increasingly being destroyed while, in exchange, wetlands are restored in rural areas. This problem can be remedied by restricting trades between donor and recipient regions. But this adds one more layer of administrative complication, which raises the costs. If the hot spot problem is too severe, trading may not be a good idea

7.2.7 *Assuring improvements in environmental objectives*

If desirable environmental behaviours would have taken place in absence of the trading, this market instrument adds nothing to meaningful policy tools. For example, in the case of carbon trading, if an agent receives reduction credits for actions that would be taken anyway, such as reduced timbering, reforestation or emissions reductions, the tradable permit just gives the agent added wealth. However, determining whether an action would have been taken in the absence of the permits is difficult. This risk may be small relative to what can be gained more broadly from the use of tradable permits. There will likely be errors in administration, but these may be acceptable relative to the potential gains from institutionalizing and obtaining acceptance of trading.

8. Demand enhancement

Providing a market environment in which appropriate behaviour enhances the market demand for an agent's products or services creates a reward for that behaviour. Green goods, such as organically grown coffee, are examples. These goods may be formally or informally certified, even receiving "seals of approval." Agents may create their own advertising

around the good characteristics of their products, production processes or agent behaviour unrelated to the product. This may enhance the products' distinctiveness, resulting in larger sales or price premiums. While these demand-enhancing, market-based programs may be useful in achieving environmental objectives they have well-known pitfalls.

8.1 Opportunities related to demand enhancement

A potentially useful opportunity ties agent conservation activities and land practices to the agent's products. Timbering and farming practices could be certified as conservation "friendly" and, as in the case of organically grown products, may bear a premium in the market. Banrock Station winery in Australia markets its participation in the management of Banrock Station wetlands and its contributions to wetland conservation. Shade-grown coffee, which aims to protect forest canopies for wildlife, is another well-known example of tying a private good to a public environmental good. Another example is the certification program of the Forest Stewardship Council that certifies individuals or corporations as practicing good forest management (http://www.fsc.org). Although most certification programs focus on habitat protection, there are a few associated with the harvesting of individual animals or plants, such as the Marine Aquarium Council's program to certify fish harvesting practices in the international aquarium trade.

8.2 Pitfalls related to demand enhancement

8.2.1 *Value added*

A major pitfall is whether there would be enough demand enhancement to merit the agent's effort. Some products or services receive no value-added from being characterized as "green". In other cases, consumers may be willing to pay more for a green product, but not enough to cover the increased costs associated with producing the environmentally-friendly commodity.

8.2.2 *Certification and monitoring*

A second pitfall is the certification process and subsequent monitoring. If certification has no basis in fact, false claims by agents will make consumers leery of certification. There may also be confusion about whether a product is really good for the environment, particularly when the product has both pluses and minuses. Once certification is obtained, agents may alter their products in ways that make them less green; so regular monitoring and recertification is necessary.

Maintaining the distinction of the product may be difficult when there are not separate market distribution networks that keep the friendly products distinct from others. This may be increasingly true as globalization of product markets erases the distinctiveness and origin of products.

8.2.3 *Competition in industry*

While certification can be useful in enhancing product demand, it also has the potential to be used to restrict entry into an industry. For example, while organic products may distinguish sellers, organic certification processes may be so tailored and complicated by existing organic farmers that they create barriers to entry into the industry.

8.2.4 *Sharing the benefits*

Price premiums associated with biodiversity friendly products need to be channelled back to producers. Evidence suggests that with some products it is traders and middlemen who gain disproportionately (Bacon 2005).

8.2.5 *Disadvantaging poor producers*

There is some reluctance and scepticism surrounding motives for introducing eco-labelling and certification schemes given that they inadvertently discriminate against producers who meet the criteria but are not participating in a scheme.

8.2.5 *Label Fatigue*

From the perspective of the consumer, a proliferation of certification schemes

CONCLUSION

Conservation activities are always fraught with issues of costs, benefits, disproportionate impacts, monitoring and enforcement. Market-based instruments can be useful if they help achieve conservation objectives at lower costs, with higher benefits, without undue adverse impacts on selected persons, and with more manageable monitoring and enforcement. Market-based instruments that place prices on ecological services, land uses or other activities establish obligations to pay for what is lost, or receive payment for what is gained. Clear pricing signals make economic calculations regarding conservation activities relatively straightforward, and can be fine tuned to establish many conservation objectives. These instruments can either be punitive, as taxes or fees, or rewarding, such as subsidies and payments. Trading instruments allow for the transferof responsibilities to agents most able to gain, such as those who can achieve conservation objectives most cost-effectively. These instruments can facilitate achieving conservation goals most cheaply and, consequently, may allow for the establishment of even higher objectives.

Demand-based instruments may be somewhat less clear cut than the pricing and trading instruments, since it is not clear how the market demand for an agent's products will be enhanced through the conservation activities. Financial instruments, such as deposit-refund programs or performance bonds, can establish clear, long-term signals regarding whether conservation objectives have actually been achieved.

ACKNOWLEDGEMENTS

The initiation of this work came out of the Valuing Wild Nature workshop (University of East Anglia March 12-16, 2006) sponsored by the Royal Society for the Protection of Birds, Natural England, the UK Government's Department for Environment, Food and Rural Affairs and the Centre for Economic and Social Change in the Global Environment, University of East Anglia.

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